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ENGINEERING CHANGE NOTICE

Page 1 of 2

1. ECN 653816

Proj. ECN

2. ECN Category (mark one)	3. Originator's Name, Organization, MSIN, and Telephone No.	4. USQ Required?	5. Date
Supplemental [] Direct Revision [X] Change ECN [] Temporary [] Standby [] Supersedure [] Cancel/Void []	Juergen H. Rasmussen, Data Assessment and Interpretation, R2-12, 373-1128	[] Yes [X] No	05/26/99
	6. Project Title/No./Work Order No. Tank 241-BX-103	7. Bldg./Sys./Fac. No. 241-BX-103	8. Approval Designator N/A
	9. Document Numbers Changed by this ECN (includes sheet no. and rev.) WHC-SD-WM-ER-535, Rev. 0-B	10. Related ECN No(s). ECNs: 640359, 647972	11. Related PO No. N/A

12a. Modification Work	12b. Work Package No.	12c. Modification Work Complete	12d. Restored to Original Condition (Temp. or Standby ECN only)
[] Yes (fill out Blk. 12b) [X] No (NA Blks. 12b, 12c, 12d)	N/A	N/A Design Authority/Cog. Engineer Signature & Date	N/A Design Authority/Cog. Engineer Signature & Date

13a. Description of Change

13b. Design Baseline Document? [] Yes [X] No

This ECN has been generated in order to update the document to reflect results of recent data/information evaluation.

Replace pages:
ES-7, ES-8, 1-1, 1-2, 2-7, 2-8, 3-3, 3-4, 5-1, 5-2, 5-7 through 5-10, 6-1, 6-2, and 7-1 through 7-4

14a. Justification (mark one)

Criteria Change	[X]	Design Improvement	[]	Environmental	[]	Facility Deactivation	[]
As-Found	[]	Facilitate Const	[]	Const. Error/Omission	[]	Design Error/Omission	[]

14b. Justification Details

A tank characterization report page change revision is required to reflect the results of recent evaluation of data/information pertaining to adequacy of tank sampling for safety screening purposes (Reynolds et al. 1999, Evaluation of Tank Data for Safety Screening, HNF-4217, Rev. 0, Lockheed Martin Hanford Corporation, Richland, Washington).

15. Distribution (include name, MSIN, and no. of copies)

See attached distribution.

RELEASE STAMP

DATE MAY 27 1999

STA: 4

HANFORD RELEASE

ID: 58

A-7900-013-2 (05/96) GEF095

A-7900-013-1

ENGINEERING CHANGE NOTICE

1. ECN (use no. from pg. 1) ECN-653816

16. Design Verification Required	17. Cost Impact				18. Schedule Impact (days)	
	ENGINEERING		CONSTRUCTION			
[] Yes	Additional	[] $	Additional	[] $	Improvement	[]
[X] No	Savings	[] $	Savings	[] $	Delay	[]

19. Change Impact Review: Indicate the related documents (other than the engineering documents identified on Side 1) that will be affected by the change described in Block 13. Enter the affected document number in Block 20.

SDD/DD	[]	Seismic/Stress Analysis	[]	Tank Calibration Manual	[]
Functional Design Criteria	[]	Stress/Design Report	[]	Health Physics Procedure	[]
Operating Specification	[]	Interface Control Drawing	[]	Spares Multiple Unit Listing	[]
Criticality Specification	[]	Calibration Procedure	[]	Test Procedures/Specification	[]
Conceptual Design Report	[]	Installation Procedure	[]	Component Index	[]
Equipment Spec.	[]	Maintenance Procedure	[]	ASME Coded Item	[]
Const. Spec.	[]	Engineering Procedure	[]	Human Factor Consideration	[]
Procurement Spec.	[]	Operating Instruction	[]	Computer Software	[]
Vendor Information	[]	Operating Procedure	[]	Electric Circuit Schedule	[]
OM Manual	[]	Operational Safety Requirement	[]	ICRS Procedure	[]
FSAR/SAR	[]	IEFD Drawing	[]	Process Control Manual/Plan	[]
Safety Equipment List	[]	Cell Arrangement Drawing	[]	Process Flow Chart	[]
Radiation Work Permit	[]	Essential Material Specification	[]	Purchase Requisition	[]
Environmental Impact Statement	[]	Fac. Proc. Samp. Schedule	[]	Tickler File	[]
Environmental Report	[]	Inspection Plan	[]		[]
Environmental Permit	[]	Inventory Adjustment Request	[]		[]

20. Other Affected Documents: (NOTE: Documents listed below will not be revised by this ECN.) Signatures below indicate that the signing organization has been notified of other affected documents listed below.

Document Number/Revision	Document Number/Revision	Document Number Revision
N/A		

21. Approvals

	Signature	Date		Signature	Date
Design Authority			Design Agent		
Cog. Eng.	J.H. Rasmussen J.H. Rasmussen	5/27/99	PE		
Cog. Mgr.	K.M. Hall Kathleen M. Hall	5/27/99	QA		
QA			Safety		
Safety			Design		
Environ.			Environ.		
Other			Other		

DEPARTMENT OF ENERGY

Signature or a Control Number that tracks the Approval Signature

ADDITIONAL

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Tank Characterization Report for Single-Shell Tank 241-BX-103

Juergen H. Rasmussen
Lockheed Martin Hanford Corp., Richland, WA 99352
U.S. Department of Energy Contract 8023764-9-K001

EDT/ECN: ECN-653816 UC: 2070
Org Code: 74B20 CACN/COA: 102217/EI00
B&R Code: EW 3120074 Total Pages: 106

Key Words: Waste Characterization, Single-Shell Tank, SST, Tank 241-BX-103, Tank BX-103, BX-103, BX Farm, Tank Characterization Report, TCR, Waste Inventory, TPA Milestone M-44

Abstract: N/A

DATE HANFORD RELEASE
STA: 4
ID: 58
MAY 27 1999

5/27/99

Release Approval Date Release Stamp

Approved for Public Release

RECORD OF REVISION	(1) Document Number WHC-SD-WM-ER-535	Page 1

(2) Title
Tank Characterization Report for Single-Shell Tank 241-BX-103

CHANGE CONTROL RECORD

(3) Revision	(4) Description of Change - Replace, Add, and Delete Pages	Authorized for Release (5) Cog. Engr.	(6) Cog. Mgr. Date
0	(7) Initially released 04/03/96 on EDT 615370.	K. E. Bell	J. G. Kristofzski
0A RS	Incorporate per ECN-640359.	M. J. Kupfer	K. M. Hodgson
		M J Kupfer 8-29-97	K M Hodgson 8/18/97
0B RS	Incorporate per ECN-647972	M.J. Kupfer	K.M. Hodgson
		MJ Kupfer 9-24-98	K M Hodgson 9-23-98
0-C RS	Incorporate per ECN-653816.	J.H. Rasmussen	K. M. Hall
			Kathleen M. Hall 5/27/99

A-7320-005 (08/91) WEF168

An upper limit to a one-sided 95 percent confidence interval on the mean of 487 J/g was found for the lower half sludge from segment 1 of core 87. Thus, although no notification limits were exceeded on individual samples (Bell 1995b), the safety screening decision criterion at the 95 percent confidence limit was not met for energetics on the lower half segment portion of segment 1 of core 87. Values for percent water on sludge samples from the 1995 core samples ranged from 22.14 to 63.17 percent. The safety screening criterion was 17 percent. The percent water of the drainable liquid samples was in the 70 to 80 percent range. The total alpha results indicate that plutonium concentration is well below the safety screening criterion of 1 g/L. The highest total alpha activity measured was 5.17 μCi/g.

The sampling and analyses were sufficient to satisfy the safety screening requirements for tank 241-BX-103 (Reynolds et al. 1999). Based on analytical results, the tank appears to pose no safety concerns despite the energetics results on the lower half sludge from segment 1 of core 87. Analyses show that there is sufficient moisture in that sample to mediate the energetics concern according to the safety screening DQO. The tank headspace vapor flammability was determined to be 0 percent of the lower flammability limit (LFL) (WHC 1996). These results satisfy the safety screening DQO requirement that tank headspace flammability be < 25 percent of the LFL. Tank headspace flammability was measured in the field in March 1996 on vapor samples drawn from below riser 7. The safety screening DQO optimization guidelines call for two full vertical profiles of the tank waste from risers as widely spaced as practical. This guideline was not strictly met for tank 241-BX-103 because no sample was obtained from the lower half of segment 2, core 87. Nevertheless, the safety screening data, obtained on the samples collected, do not indicate the presence of any safety concerns and support the non Watch List status of tank 241-BX-103.

1.0 INTRODUCTION

This tank characterization report presents an overview of single-shell tank 241-BX-103 and its waste contents. It provides estimated concentrations and inventories for the waste components based on the latest sampling and analysis activities and background tank information, and it supports the requirements of the *Hanford Federal Facility Agreement and Consent Order*, Milestone M-44-09 (Ecology et al. 1994).

Tank 241-BX-103 began operation in 1948 and received waste until it was removed from service in 1977. Interim stabilization and intrusion prevention of the tank were completed in 1983 and 1985, respectively; therefore, the composition of the waste is not expected to change until pretreatment and retrieval activities commence. The analyte concentrations reported in this document reflect the best composition estimates of the waste based on the available analytical data and historical models.

1.1 PURPOSE

The purpose of this report is to summarize the information about the use and contents of tank 241-BX-103. Where possible, this information will be used to assess issues associated with safety, operations, environmental, and process development activities. This report also serves as a reference point for more detailed information concerning tank 241-BX-103.

1.2 SCOPE

This characterization report presents the results of earlier supernate sampling and the only sampling events pertinent to the current contents of the tank, a core sampling event in May 1995 and tank headspace vapor measurements in March 1996. These sampling events supported the evaluation of the tank waste according to the *Tank Safety Screening Data Quality Objective* (Babad and Redus 1994). The data presented here will be evaluated against a more recent revision of the safety screening DQO document (Dukelow et al. 1995). From the two core samples, three analyses were performed as directed in the *Tank 241-BX-103 Tank Characterization Plan* (Bell 1995b). The safety screening analyses performed were differential scanning calorimetry (to evaluate fuel level and energetics), thermogravimetric analysis (to determine moisture content), total alpha activity analysis (to evaluate criticality potential) and percent of the Lower Flammability Limit (LFL) of the tank headspace. The results of these analyses are used to categorize a tank as "safe" or to identify it with a specific safety issue.

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quarter of 1951 when the cascade was closed. Tank 241-BX-103 remained filled with metal waste until it was sluiced for uranium recovery in 1954. It was declared empty in July of that year (Rodenhizer 1987).

In the third quarter of 1956, tank 241-BX-103 was filled with uranium recovery waste from tank 241-BY-108. During 1956 and 1957, most of the waste was pumped to the cribs.

Transfer activity resumed in 1962 as tank 241-BX-103 began receiving a series of transfers of PUREX cladding and organic wash waste from tanks in the 241-C Tank Farm. From 1969 to 1976, the tank received wastes from the PUREX Plant, B Plant, and other sources through tanks 241-B-101, -BX-101, -BX-104, -BX-105, and -BX-106. During this time period, there also were frequent transfers from tank 241-BX-103 to tanks in the 241-B, -BY, -BX, -C, -S, and -SX tank farms. Approximately 598 kL of waste remained in tank 241-BX-103 after the final transfer from it in 1976.

Tank 241-BX-103 was saltwell pumped in 1977. It was administratively interim stabilized in November 1983; intrusion prevention was completed in October 1985.

2.3.2 Historical Estimate of Tank Contents

An estimate of the current contents of tank 241-BX-103 based on historical transfer data is available in the *Tank Layer Model for the Northeast, Southwest, and Northwest Quadrants* (TLM) (Agnew et al. 1995). The historical data used for the TLM prediction may be found in the *Waste Status and Transaction Record Summary for the Northeast Quadrant* (WSTRS) (Agnew et al. 1994), and *Hanford Defined Waste: Chemical and Radionuclide Compositions* (HDW) (Agnew 1995). The WSTRS document is a compilation of available waste transfer and volume status data. The HDW document provides the assumed typical compositions for Hanford Site waste types. The available data are incomplete, thereby reducing the usefulness of the transfer data and the modeling results from which it is derived. The TLM document uses WSTRS data to model the waste deposition processes, then, using additional data from HDW (which may introduce error), generates an estimate of the tank contents. Thus, these model predictions can only be considered estimates that require further evaluation using analytical data.

According to the TLM, the waste in tank 241-BX-103 exists in three layers: 203 kL of metal waste, 30 kL of unknown waste, and 15 kL of supernate. The metal waste is predicted to comprise the bottom layer, the top layer is supernate, and the middle layer is an unknown waste type, although Agnew et al. (1995) suggests that this layer is likely to be PUREX cladding waste. Metal waste sludge contains sodium, uranium, carbonate, phosphate, sulfate, and hydroxide. In addition, high concentrations of strontium and cesium should be present. The following constituents should be absent from metal waste: aluminum, iron, bismuth, nickel, lead, and organic carbon. Predicted waste constituents and concentrations for tank 241-BX-103 solids are shown in Table 2-4.

Table 2-4. Tank 241-BX-103 Historical Tank Content Estimate (2 sheets).[1]

Solids Composite Inventory Estimate[2]			
Physical Properties			
Total solid waste	3.54E+05 kg		
Heat load	132 W		
Bulk density	1.51 g/mL		
Void fraction	0.522		
Water wt%	59.0		
Total organic carbon	0% C		
Chemical Constituents			
Analyte	**Concentration**		**Inventory**
	(mol/L)	**(µg/g)**	**(kg)**
Na^+	4.38	66,800	23,600
Al^{3+}	0.756	13,500	4,790
Fe^{3+} (total Fe)	0.447	16,600	5,860
Cr^{3+}	0.00441	152	53.8
Bi^{3+}	0	0	0
La^{3+}	0	0	0
Ce^{3+}	0	0	0
Zr (as $ZrO(OH)_2$)	0	0	0
Pb^{2+}	0	0	0
Ni^{2+}	0.0276	1,070	380
Sr^{2+}	0	0	0
Mn^{4+}	0	0	0
Ca^{2+}	0.0613	1,630	577
K^+	0	0	0
OH^-	9.23	1.04E+05	36,800
NO_3^-	0.191	7,860	2,780
NO_2^-	0.0280	854	302
CO_3^{2-}	0.703	28,000	9,900
PO_4^{3-}	0.412	26,000	9,180
SO_4^{2-}	0.787	50,200	17,700
Si (as SiO_3^{2-})	0.00180	33.6	11.9
F^-	0	0	0
Cl^-	0.00354	83.3	29.5

Table 3-2. Tank 241-BX-103 Subsampling Scheme and Sample Description.[1]

Core: Seg: Riser	Date Sampled	Date Extruded	Liquid Recovered (grams)	Solids Recovered (grams)	Sample Description
86:1:7	5/24/95	5/31/95	221.71	33.91 (upper half)	Collected less than 5 mL of liner liquid, which was not retained. Recovered roughly 10 cm of solid material and about 210 mL of black, turbid drainable liquid. The solids were black, with a very wet consistency and a grainy texture. They were collected in one jar as the upper half of the segment.
86:2:7	5/26/95	5/31/95	21.39	86.68 (upper half) 195.54 (lower half)	Less than 5 mL of liner liquid was recovered, but not retained. Collected were 13 cm of sample from the upper half and 23 cm from the lower half of the segment. About 20 mL of black, turbid drainable liquid was also recovered. During the extrusion, the sampler push piston could not be pushed through the last 5 cm of the valve head, therefore the remaining solids were removed from the sampler with a spatula. All the solids were black and wet with a grainy texture. The interior of the sample contained a white, chalky material.
87:1:2	5/30/95	6/5/95	214.51	70.10 (upper half) 24.54 (lower half)	About 5 cm of solids were recovered shortly after the extrusion was begun and taken as the lower half of the segment. An additional 13 cm of solids sample was collected near the end of the extrusion and taken as the upper half of the segment. All solid material was black and shiny, with a grainy texture. Also collected were approximately 190 mL of turbid, black drainable liquid.
87:2:2	5/30/95	6/5/95	18.25	244.71 (upper half)	Prior to extrusion, less than 5 mL of liner liquid was recovered, but not retained. It was noted on the chain-of-custody form accompanying this sample that the "bottom alarm went off 16 3/4" into the stroke" such that only 42.5 cm of sample was expected. Collected toward the end of the extrusion were 23 cm of sludge, designated as the upper half of the segment. The solids were very dark brown sludge mixed with yellow-colored material. Most of the yellow material was present in the middle 13 cm of the sample. It was somewhat crumbly in some areas, but had a smooth consistency in other areas. The dark material generally had a smooth consistency. Approximately 15 mL of turbid, dark brown drainable liquid was also recovered.

Note:

[1]Bell (1995a)

3.4 SAMPLE ANALYSIS

The analyses performed at the half segment level on 1995 core samples 86 and 87 were limited to those needed to satisfy the safety screening requirements. The results of these analyses have been reported in the *90-Day Safety Screen Results and Final Report for Tank 241-BX-103, Push-Mode, Cores 86 and 87* (Bell 1995a). No individual sample results exceeded the safety screening DQO notification limits, although sample from the lower half sludge of segment 1, core 87 did exceed the safety screening limit of 480 J/g (dry) at the upper limit to the one-sided 95 percent confidence interval of the mean. That upper limit was 487 J/g (dry). A list of all samples by core, riser, segment portion, and sample number, and their associated analyses is shown in Table 3-3. The procedures used for these analyses are identified in Table 3-4. TGA and DSC analyses were performed under a nitrogen purge. Total alpha activity was determined by an alpha proportional counter on aliquots of samples that had been fused in potassium hydroxide and subsequently dissolved in hydrochloric acid.

Laboratory control standards, matrix spikes, and duplicate analysis quality control checks were applied to the total alpha activity analysis. Laboratory control standards and duplicate analysis quality control checks were used for the TGA and the DSC analyses. Assessment of the quality control data is in Section 5.1.2.

3.5 DESCRIPTION OF TANK HEADSPACE SAMPLING EVENT

Tank BX-103 headspace flammability was tested March 27, 1996, to satisfy the tank headspace flammability screening requirement of the safety screening DQO (Dukelow et al. 1995). Tank headspace flammability was determined in the field by means of a combustible gas meter while drawing a sample of the tank headspace from a point below riser 7 (WHC 1996). The combustible gas meter indicated that the tank headspace was 0 percent of the LFL, which satisfies the safety screening DQO requirement that the tank headspace be $<$ 25 percent of the LFL.

5.0 INTERPRETATION OF CHARACTERIZATION RESULTS

The purpose of this section is to evaluate the overall quality and consistency of the available analytical results for tank 241-BX-103 and to assess and compare these results against historical information and program requirements.

5.1 ASSESSMENT OF SAMPLING AND ANALYTICAL RESULTS

This section evaluates sampling and analysis factors that may impact interpretation of the data. These factors are used to assess the overall quality and consistency of the data and to identify limitations in the use of the data. Normal consistency checks include the following: calculating a mass and charge balance, comparing total alpha activity results with the sum of individual alpha emitters, and comparing phosphorus and sulfur concentrations determined by inductively coupled plasma with phosphate and sulfate concentrations determined by ion chromatography. None of these comparisons were possible for tank 241-BX-103 because of very limited data. Therefore, the only measures of data quality for the safety screening results were the laboratory quality control information (see Section 5.1.2).

5.1.1 Field Observations

Only field observations relative to the 1995 core samples are discussed here. No field observation data is available from previous sampling events, and analytical results from those efforts are for comparison only rather than for calculating tank inventories.

There were specific differences in color, consistency, and drainable liquid content in the samples retrieved during the 1995 sampling event. The differences were slight and are not expected to impact the interpretation of the available data. Descriptions and photographs of the extruded core samples are in Section 3.3 and Appendix B, respectively. The photographs show there was poor correlation between expected and actual sample recovery. Resolution of the three primary safety screening DQO analytical requirements is at the half-segment level for solid samples. Optimal sampling requirements of the DQO are two full-depth core or auger samples. No sample was obtained from the lower half of segment 2 of core 87. This amounts to about 28 percent of the expected core sample. However, the sampling was sufficient to fulfill the safety screening requirements (Reynolds et al. 1999). None of the data collected suggest there are any safety concerns associated with tank 241-BX-103.

5.1.2 Quality Control Assessment

Quality control assessment of the 1995 push-mode core sample from tank 241-BX-103 includes an evaluation of blanks, duplicates, spikes, and standards that were performed in conjunction with the chemical analyses. The required, program-specific quality control elements are defined in Bell (1995b). They were conducted on the two 1995 push-mode core samples, allowing for an assessment regarding the accuracy and precision of the safety screening data. A summary of the quality control failures with respect to these data is shown in Table 5-1. It should be noted that all analyses met internal laboratory quality control requirements.

Table 5-1. 1995 Core Samples: Summary of Quality Control Failures[1].

Sample (Core:Seg:Portion)	Analysis	Quality Control Failure	Count Error (%)
86:1:upper half	total alpha	RPD 11.5%	9.9
86:2:upper half	total alpha	Std 79.05%	33.3
86:2:lower half	DSC	RPD 200%	n/a
87:2:upper half	TGA	RPD 16.8%[2]	n/a
87:2:upper half	% water by gravimetry	RPD 60.2%[2]	n/a
87:2:upper half	total alpha	Std 79.05%	170

Notes:

Std = standard
n/a = not applicable

[1]As defined by the tank 241-BX-103 characterization plan (Bell 1995b). Criteria include the following: standard recovery of 90 to 110 percent, spike recovery of 90 to 110 percent, and an RPD of duplicate analyses ≤ 10 percent.

[2]A rerun was performed with satisfactory results.

Standards contain the analytes of interest at known concentrations and are used to estimate the accuracy of the analytical method. They are evaluated once per batch prior to and concurrent with sample analysis. The criterion for an acceptable standard recovery for the 1995 core samples, as defined in the safety screening DQO document, is 90 to 110 percent. If a standard is above or below the criterion, the analytical results may be biased high or low, respectively. Standards are required on all safety screening analyses.

Matrix spikes are used to estimate the bias of the analytical method caused by matrix interferences. Spiked samples are prepared by splitting a sample into two aliquots and adding a known amount of a particular analyte to one aliquot to calculate a percent recovery. The safety screening quality control criterion for matrix spikes is 90 to 110 percent recovery. If a spike is above or below this criterion, the analytical results may be biased high or low, respectively. Spike recoveries are not applicable to the DSC and TGA analysis methods. The tank 241-BX-103 characterization plan requires a spike once per matrix on total alpha analyses; therefore, a spike was performed on one sludge sample from each core.

5.5 EVALUATION OF PROGRAM REQUIREMENTS

This section details data needs as defined in the *Tank Safety Screening Data Quality Objective* (Dukelow et al. 1995). The 1995 sampling and analysis effort was carried out under an earlier revision of the safety screening DQO document (Babad and Redus 1994). Evaluation of 1995 data will be made against the later revision cited above. The safety screening DQO document was developed to allow rapid classification of waste tanks into specific categories associated with safety issues. It also establishes decision criteria or notification limits for concentrations of analytes of concern. These decision criteria are used to determine whether a tank is safe or if further investigation into the tank's safety is warranted. If results from any primary analysis exceeds a decision criterion, the tank will not be classified "safe," and further analyses will be conducted to assure tank safety. The available data were insufficient to assess impacts on operational, environmental, or process development programs.

The decision criteria used to determine whether a tank is safe or should be identified with a specific safety issue are as follows: 1) energetics (no DSC exotherm exceeds 480 J/g), 2) flammable gas concentration (any flammable gas present in the tank headspace is less than 25 percent of the lower flammability limit), and 3) total alpha activity less than 1 g/L[1]. The earlier revision of the safety screening DQO, against which the sampling and analysis of the 1995 core samples was performed, also included as a criterion that percent water should be greater than 17 percent. The safety screening DQO document requires a 95 percent confidence that each decision criterion has been met (Dukelow et al. 1995). Thus, for a given analyte, the notification limit on an individual measurement does not have to be exceeded to preclude the tank from being declared safe, provided the notification limit is below the upper 95 percent confidence limit. This is the case for the DSC measurements discussed in Section 5.5.1. If a criterion is not met, further analyses are conducted to determine the specific safety issue with which the tank should be identified.

A statistical analysis of the safety screening data was performed to determine whether, with 95 percent confidence, the decision criteria were satisfied. The analytical results were compared with the decision criteria by computing upper limits to one-sided, 95 percent confidence intervals on the means. The 95 percent confidence limit for each analysis is given in Tables 4-2, 4-3, 4-4, and 4-6. For the DSC and total alpha analyses, the upper limit to the confidence interval was computed on the mean. If the upper limit is greater than 480 J/g or 41 μCi/g respectively, the decision criterion is exceeded. For percent moisture by

[1]Although the actual decision criterion listed in the safety screening DQO is 1 g/L, total alpha is measured in μCi/g. To convert the criterion into the practical units of μCi/g, it was assumed that all alpha decay originated from ^{239}Pu. Assuming a sludge density of 1.5 and using the specific activity of ^{239}Pu, the decision criterion is derived as shown:

$$\left(\frac{1\ g}{L}\right)\left(\frac{1\ L}{10^3\ mL}\right)\left(\frac{1\ mL}{1.5\ g}\right)\left(\frac{0.0615\ Ci}{1\ g}\right)\left(\frac{10^6\ \mu Ci}{1\ Ci}\right) = 41\frac{\mu Ci}{g}$$

TGA, the lower limit of the confidence interval was computed. If the lower limit is less than 17 percent, then the decision criterion is exceeded.

5.5.1 Safety Evaluation

With respect to the 1995 core samples, the optimal sampling requirement that a vertical profile of the tank be obtained from two widely spaced risers was not fulfilled. However, sampling was sufficient for safety screening (Reynolds et al. 1999). The lower half segment portion was missing from segment 2 of core 87. All four primary analytical requirements (energetics, total alpha activity, moisture content, headspace flammability) were met. The 95 percent confidence decision criteria thresholds were not met for TGA on the upper half of segment 2, core 87, and for DSC for the lower half of segment 1 of the same core, even though the notification limit on individual measurements was not exceeded.

The potential for criticality can be assessed from the total alpha data. None of the individual samples from the 1995 data contained total alpha activity greater than 5.17 μCi/g, and the overall mean result was 3.13 μCi/g. This was well below the notification limit of 41 μCi/g or 1 g/L as specified in the safety screening DQO.

Another factor in assessing the safety of tank waste is the heat generation and temperature of the waste. Heat is generated in the tanks from radioactive decay. The major radionuclides (^{90}Sr and ^{137}Cs) that contribute to heat generation were not analyzed in the 1995 sampling; therefore, an estimate based on sampling results cannot be made. However, the HTCE estimate for heat load is 132 W, well below the 11,700 W threshold that differentiates high- and low-heat load tanks. Furthermore, the historical temperature records do not indicate any sign of excessive heat generation.

The tank 241-BX-103 safety screening DQO decision criteria and results of the 1995 push-mode core sample and the 1996 tank headspace sample are summarized in Table 5-2. The tank BX-103 headspace flammability determination of March 27, 1996, revealed that the tank headspace flammability is 0 percent of the LFL (WHC 1996). This result meets the safety screening DQO requirement that the tank headspace flammability be $<$ 25 percent of the LFL. Information in the table indicates that the safety screening DQO sampling requirements may not have been met. However, there are no immediate safety concerns associated with the tank although TGA and DSC notification limits were exceeded at the 95 percent confidence level. The upper half of segment 2 of core 87, which showed low moisture in the solids (at the lower 95 percent confidence limit), showed no exotherm in the DSC scans. The lower half of segment 1 of core 87, which showed a large exotherm (at the upper 95 percent confidence level), contained adequate moisture at 61 percent to mediate any propagating, exothermic reaction.

Table 5-2. Tank 241-BX-103 Safety Screening Data Quality Objective Decision Criteria and Results.

Safety Screening Decision Criterion	Decision Criterion Threshold (at 95% Confidence)	Does decision criterion meet 95% confidence limit on all subsegments?
Total fuel content	< 480 J/g (dry-weight basis)	No[1]
Percent moisture	> 17%	No
Total alpha	< 1 g/L	Yes
Flammable gas	< 25% of lower flammability limit	Yes

Notes:

[1]Pertains to the lower half sludge from segment 1 of core 87. Neither the sample nor duplicate result exceeded the decision criterion threshold, but that subsegment did not meet the threshold at the upper limit to a one-sided 95 percent confidence interval on the mean.

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6.0 CONCLUSIONS AND RECOMMENDATIONS

The most recent core sampling of tank 241-BX-103 was completed in May 1995; tank headspace flammability was determined in March 1996. The supernate analyses performed earlier do not represent an accurate waste composition. Because the 1995 core sampling event focused on safety screening criteria and because the safety screening analyses are the only ones available to represent the current waste in the tank, the chemical and radiochemical composition of the waste must be estimated from historical information. That information must be used with caution, but indicates the waste contains a layer of supernate and two layers of sludge with high concentrations of sodium, uranium, carbonate, phosphate, sulfate, and hydroxide. In addition, high concentrations of strontium and cesium should be present.

Analysis of the 1995 core samples indicates that the moisture content of tank 241-BX-103 sludge is significantly above the safety screening criterion of 17 percent with the exception of sludge from the upper half of segment 2, core 87. The lower 95 percent confidence limit on the mean for this segment portion was 16.8 percent water, and the mean of sample and duplicate runs was 23 percent. The next lowest moisture content for a sludge was 29.4 percent found in the lower half of segment 2, core 86. Exotherms were observed on four samples, the largest of which was 423 J/g on a dry-weight basis. Although all individual results were below the safety screening criterion of 480 J/g, the upper 95 percent confidence limit on the mean was 487 J/g (dry) for the sludge from the lower half of segment 1, core 87. However, the moisture in this segment portion was found to be 61.3 percent. All total alpha results were at least a factor of eight below the safety screening criterion. Additionally, the heat load of 132 W from the radioactive decay of radionuclides was well below the threshold of 11,700 W that separates high-heat from low-heat tanks.

The 1995 sampling and analysis event for tank 241-BX-103 was sufficient to meet the sampling requirement of the safety screening DQO (Reynolds et al. 1999). Two risers radially separated by approximately 180° were sampled, but the lower half segment portion from segment 2 of core 87 was not obtained. All primary safety screening analyses on the sludge and drainable liquid were completed, and tank headspace flammability measurements were performed. Safety screening results from the sludge and drainable liquid samples at the 95 percent confidence level do not indicate any safety concerns. The tank headspace was measured at 0 percent of the LFL, thus tank headspace flammability is not an issue with tank 241-BX-103.

The analytical results for percent water and total alpha from the two core samples were compared to the TLM document in Section 5.4. Neither the TGA nor the total alpha data compare well with the tank inventory estimate. This discrepancy may be caused by a TLM over-estimation of the amount of metal waste in the tank, the presence of unknown waste types, and lack of activities of alpha-emitting isotopes other than Pu. It is possible that the sludge is largely composed of other waste types (see Section 2.3.2). The segment extrusion and TGA data do support the layering model found in the TLM document. Tank waste layering is apparent based on photographic and videographic information as well as the analytical results, the tank fill history, and the visual descriptions of the extruded samples.

7.0 REFERENCES

Agnew, S. F., 1995, *Hanford Defined Wastes: Chemical and Radionuclide Compositions*, WHC-SD-WM-TI-632, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Agnew, S. F., P. Baca, R. Corbin, K. Jurgensen, and B. Young, 1995, *Tank Layer Model for Northeast, Southwest, And Northwest Quadrants*, LAUR-94-4269, Rev. 1, Los Alamos National Laboratory, Los Alamos, New Mexico.

Agnew, S. F., P. Baca, R. Corbin, T. Duran, and K. Jurgensen, 1994, *Waste Status and Transaction Record Summary for the Northeast Quadrant*, WHC-SD-WM-TI-615, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

Alstad, A. T., 1993, *Riser Configuration Survey for SSTs*, WHC-SD-RE-TI-053, Rev. 9, Westinghouse Hanford Company, Richland, Washington.

Anderson, J. D., 1990, *A History of the 200 Area Tank Farms*, WHC-MR-0132, Westinghouse Hanford Company, Richland, Washington.

Babad, H., and K. S. Redus, 1994, *Tank Safety Screening Data Quality Objective*, WHC-SD-WM-SP-004, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Bell, K. E., 1995a, *90-Day Safety Screen Results and Final Report for Tank 241-BX-103 Push-Mode*, Cores 86 and 87, WHC-SD-WM-DP-135, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

Bell, K. E., 1995b, *Tank 241-BX-103 Tank Characterization Plan*, WHC-SD-WM-TP-339, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Brevick, C. H., L. A. Gaddis, and E. D. Johnson, 1994, *Supporting Document for the Northeast Quadrant Historical Tank Content Estimate Report for the BX Tank Farm*, WHC-SD-WM-ER-311, Rev. 0, ICF Kaiser Hanford Company, Richland, Washington.

De Lorenzo, D. S., A. T. DiCenso, D. B. Hiller, K. W. Johnson, J. H. Rutherford, B. C. Simpson, and D. J. Smith, 1994, *Tank Characterization Reference Guide*, WHC-SD-WM-TI-648, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Dukelow, G. T., J. W. Hunt, H. Babad, and J. E. Meacham, 1995, *Tank Screening Data Quality Objectives*, WHC-SD-WM-SP-004, Rev. 2, Westinghouse Hanford Company, Richland, Washington.

Ecology, EPA, and DOE, 1994, *Hanford Federal Facility Agreement and Consent Order*, as amended, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington.

Hanlon, B.M., 1996, *Waste Tank Summary Report for Month Ending January 31, 1996*, WHC-EP-0182-94, Westinghouse Hanford Company, Richland, Washington.

Huber, J. H., 1994, *Single-Shell Waste Tank Intrusion Resolution Plan*, WHC-SD-WM-WP-266, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Johnson, G. D., 1995, "Action Item for Laboratory Restart," (Internal Memo to J. G. Kristofzski, June 23, 1995), Westinghouse Hanford Company, Richland, Washington.

Reynolds, D. A., W. T. Cowley, J. A. Lechelt, B. C. Simpson, and C. DeFigh-Price, 1999, *Evaluation of Tank Data for Safety Screening*, HNF-4217, Rev. 0, Lockheed Martin Hanford Corporation, Richland, Washington.

Rodenhizer, D. G., 1987, *Hanford Waste Tank Sluicing History*, WHC-SD-WM-TI-302, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Tran, T. T., 1993, *Thermocouple Status, Single-Shell and Double-Shell Waste Tanks*, WHC-SD-WM-TI-533, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

U.S. DOE, 1986, *Piping Waste Tank Isolation 241-BX-103*, Drawing No. H-2-73314, Vitro Engineering, Richland, Washington.

Welty, R. K., 1988, *Waste Storage Tank Status and Leak Detection Criteria*, WHC-SD-WM-TI-356, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

WHC, 1996, Work Package Number ES-96-177, Westinghouse Hanford Company, Richland, Washington.

Wheeler, R. E., 1974, Letter to R. L. Walser, "Analysis of Tank Farm Samples Sample: T-8630 103-BX", dated November 25, 1974, Atlantic Richfield Hanford Company, Richland, Washington.

Wheeler, R. E., 1975a, "Analysis of Tank Farm Samples Sample: T-2764 103-BX," (Letter to R. G. Geier and R. L. Walser) dated March 27, 1975, Atlantic Richfield Hanford Company, Richland, Washington.

Wheeler, R. E., 1975b, "Analysis of Tank Farm Samples Sample: T-3635, Tank: 103-BX," (Letter to R. L. Walser, dated October 27, 1975), Atlantic Richfield Hanford Company, Richland, Washington.

Wheeler, R. E., 1975c, "Analysis of Tank Farm Samples Sample: T-5455, Tank: 103-BX," (Letter to R. L. Walser, dated March 27, 1975), Atlantic Richfield Hanford Company, Richland, Washington.

Wheeler, R. E., 1975d, "Analysis of Tank Farm Samples Sample: T-9138, Tank: 103-BX," (Letter to R. L. Walser, dated December 18, 1975), Atlantic Richfield Hanford Company, Richland, Washington.

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